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ABSTRACT

This paper provides a general overview of the forces that contributed to the rise and fall of the "new math" movement. It is noted that the movement developed as a response to certain problems in mathematics education; these problems remain to be solved. Some small-scale successes were achieved, from which we can learn. The answer to "What went wrong?" lies, the author believes, in conflicts between the pioneer curriculum reformers and the other groups interested in improving mathematical education, such as professional mathematicians. The work of the Commission on Mathematics is discussed in some detail, and comments on the School Mathematics Study Group (SMSG) are included. The new math, it is found, became "old-fashioned mathematics" presented from a modern point of view, and limited to the vocabulary of modern mathematics; it did not include any significant amount of useful modern mathematics (e.g., linear programming or statistics). References are made throughout the paper to pages from the author's doctoral dissertation, on which the paper is based. (MNS)

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A Historical View of the "New Mathematics"

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Prepared for the American Educational Research Association Symposium:

The Phenomonon of the "New Mathematics:"
What They Did, and What They Learned

Robert B. Davis, Chair
Montreal, Quebec, Canada
12 April 1983

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Abstract

This paper provides a general overview of the forces that contributed to the rise and fall of the "new math" movement. It is intended to provide a background for comments on more specific issues by other participants in the symposium. Factual information is drawn primarily from my dissertation, "A History of the 'New Math' Movement in the United States," completed at Iowa State University in 1981 under the direction of William B. Rudolph. Except as noted otherwise, all references are to this work.

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The "new math" movement came to an end when the curious concatenation of circumstances that had brought it into being had ceased to exist. If my earlier study of the "new math" had any moral, message, or conclusion, this is it. It is, I think, an important conclusion, because the conventional explanation of the demise of the "new math," the belief that it "failed," has had a profound and unfortunate effect on our ability to learn from the past. Today, mathematics educators are likely to look back on the "new math" era as on a wild, and perhaps misspent, youth; filled with energy and enthusiasm, idealism and naivete, but faintly embarrassing to look back on today. We feel we are more realistic and mature now. We have learned our lesson. No longer do we attempt to teach large doses of modern mathematics to young children. Never again shall we attempt to radically alter the school mathematics curriculum left to us by the last century.

This is a sad state of affairs, and for many different reasons. To begin with, the "new math" was originally developed as a response to certain problems in mathematics education (pp. 48-49, 67-69, 103-104, 129-133). Even if one is quite convinced that the "new math" failed in its attempt to solve these problems, indeed, <u>especially</u> if one is convinced that the "new math" failed in this attempt, there remains the problem of finding solutions to these problems that <u>do</u> work. Furthermore, even though the attempt to initiate "new math" programs on a large scale was fraught with difficulties, the fact remains that in the early years many small scale successes were achieved. We can learn something from these successes, and the problems encountered in trying to spread them. Finally, the "new math" was not a monolithic movement with a centralized leadership and uniform creed. It was, instead, a collection of very strange bedfellows indeed, brought together by circumstances, and a common interest in improving mathematics instruction. It is a mistake to lump all these reformers together, and reject their work in toto, for they reflected many different approaches, some of which still have much to offer us today. So perhaps, before we relegate the "new math" to an attic of lost and forgotten dreams, we should sift through it carefully, preserving its achievements, and learning from its mistakes.

When we look back at its origins, we find that the "new math" became a wide-spread and conspicuous phenomonon because a large number of forces happened to be pushing in the direction of mathematics curriculum reform at the same time. While I have described those forces in more detail elsewhere, a brief listing here may be worthwhile. First of all, many revolutionary changes had taken place within mathematics itself, mostly during the nineteenth century. These changes gradually filtered down through the graduate school and college curriculum, and probably would have reached the high schools in this century, and the grade schools in the next, even without a deliberate effort to bring this about. As it happened, however, "modern mathematics" was incorporated as a key element in the great majority of "new math" programs, although for a variety of reasons.

Acting more as a proximate cause for the movement was the Second World War, and a variety of events linked to it. First, Hitler's rise to power produced a steady flow of European mathematicians to the United States; such a strong flow that leadership in mathematical research and the training of mathematicians shifted from Germany to the United States. Once the War began, many immigrant and native mathematicians became involved in the mathematical training of perhaps not very mathematically inclined military recruits. For many, this probably produced only a distaste for working with such students, but in some it sparked an interest in the problems of mathematical education at a level more humble than had been customary for these mathematicians.

Other mathematicians became involved in projects applying mathematics to the technology of war. These mathematicians often were impressed by the usefulness of mathematics to technology, and excited by participation in projects that developed new ideas, such as operations research and the programable computer, in response to wartime needs. These developments also made the public and the government aware of the contribution of science and mathematics to the economic and military strength of the nation. Often these new uses of mathematics involved fairly elementary mathematics. This created a potential for these developments to influence, or be added to, the curriculum at a fairly low (perhaps high school) level. Finally, the World War gave way to the Cold War, and national feelings of paranoia regarding the military strength and intentions of the Soviet Union, all of which was brought to a head by the launching of Sputnik in 1957.

It was in this atmosphere than an anxious citizenry, a worried government, and a newly energized mathematics community turned their attention to mathematics in the schools. What they found in the schools was not terribly encouraging, but here and there some innovative programs were already under way. Now at any given moment, someone, somewhere, is probably trying something new. Most such reformers produce some improvement in their little corner of the world, which is usually little known, and soon forgotten. For the reformers of mathematics education in the late 1950s, or for some of them at least, things were different.

First of all, their work caught the interest of the mathematical community. Generally speaking, this community has taken only a perfunctory interest in pre-college mathematics education. In the early 1950s, however, mathematicians' interest in mathematics education was stimulated by both their wartime experiences, and the new importance mathematics, science, and technology had achieved in the public eye. Secondly, this same newly recognized importance of mathematics to society created an interest, among politicians, the public, and the press, in improved mathematics teaching. All of these newly interested groups began to examine curriculum reforms already under way, in the hope of finding programs they felt met their own goals for mathematics education. It is important to realize that the goals of these groups did not always coincide with one another, or with the goals of the pioneer curriculum reformers. This lack of unanimity was caused, and preserved, in part by the lack of any established patterns of cooperation--or even communication--among these groups. It had a major impact on which programs received publicity and funding in the early years of "new math," and was to be a major contributor to the problems "new math" suffered in later years.

What were the goals of these diverse groups? The public, press, and government were interested in immediate, spectacular "results." The already existing curriculum reformers were primarily interested in improving the quality of mathematical learning, often in ways that were more subtle than spectacular. They were frequently uninterested in, even wary of, attempts to reproduce their efforts on a wide scale. What the mathematicians wanted was less clear. It soon became apparent that what they wanted most was to return to their research and the college classroom. Their involvement with the mathematics curriculum of the schools was brief, but decisive. When they participated in individual programs--one thinks of Vaughan and UISCM or the many mathematicians involved in S M S G - - the result was usually a program with a strong "modern mathematics" flavor.

However, this "modern mathematics" bias was a late development. In the early 1950s, a variety of approaches were being taken to improve mathematical education. We might look briefly at a few pioneers chosen to illustrate that variety. Henry Van Engen and Maurice Hartung (pp. 215-216) developed an innovative text series in the progressive tradition of Brownell. Catherine Stern (pp. 225-226) was using blocks to help children experience mathematical concepts physically. Karl Menger (p. 98) produced a calculus text from which many of the ambiguities of traditional language and symbolism had been removed. Max Beberman, Herbert Vaughan, and their colleagues at the University of Illinois (pp. 102-107) developed a high school mathematics program incorporating both modern mathematics and an innovative approach to pedagogy. Robert Davis (p. 228) was teaching algebra and analytic geometry to disadvantaged, low I.Q. junior high school students. All of these pioneers produced valuable materials and ideas, but only Beberman attempted to teach modern mathematics to children. Of these pioneers, only Beberman and Davis became part of the "new math," and even this was an uneasy alliance. Both men eventually became disillusioned with the movement (**1981**, pp. 214-215, 231-233), and their work reached far fewer classrooms than later "new math" projects.

What went wrong? Why did the "new math" movement reject or ultimately alienate the very reformers who made that movement possible? I think the answer lies in conflicts between the pioneer curriculum reformers and the other groups interested in improving mathematical education. One of these groups consisted of professional mathematicians. Their impact as a group was perhaps first apparent in the report of the Commission on Mathematics of the College Entrance Examination Board (pp. 109-116). The Commission had been formed in 1955. Of its fourteen members, six were mathematicians associated with universities, while only one of the early "new math" pioneers, Henry Van Engen, was included. Although the Commission's report was not published until 1959, it was publicized and distributed in preliminary form before then. The report treated modern mathematics as valuable and worthy of study for its own sake. Although most articles about "new math" (other than those that were written by people who were themselves actually implementing new programs in the classroom) took the superiority of modern mathematics for granted, it is interesting to note that similar claims for the intrinsic superiority of modern art, literature, history, or music probably would not have been accepted so readily. In any case, the Commission treated modern developments in mathematics as the prime reason why curricular reform was needed. The increased social need for more and better

mathematical training was treated as secondary. The kinds of pedagogical issues raised by the "new math" pioneers were hardly mentioned. Even the work of Beberman, Vaughan, and Menger, who used modern mathematics as a tool to improve teaching, did not seem to have much impact on the pedagogical spirit of the report, although their work may have had some effect on the content of the courses the report advocated. As a result, the report marked a turning point in the development of "new math," away from concern with the quality or the mechanism of learning toward a concern with course content, in particular, a content deemed worthy by mathematicians.

The report of the Commission was a turning point in another way as well. Where earlier reform efforts had been limited to certain geographical areas, or certain courses or topics, or the production of textbooks that would become one of many options on the market place, the Commission called for a nationwide reform of the entire college preparatory high school mathematics curriculum in all schools. In addition, the Commission took steps to obtain widespread publicity and support for its program. For example, copies of this report were distributed to the members of the principal professional organizations of research mathematicians and college and high school mathematics teachers. With the Commission's attempt to sell curriculum reform on a nationwide scale, the "new math" moved from the experimental stage to the evangelical stage.

These two distinctive characteristics of the Commission's work, the emphasis on modern mathematics for its own sake, and the beginning of a nationwide movement for the reform of mathematics education, had a powerful impact on the image of "new math." What had previously been a loose collection of highly diverse and independent efforts at reform came to be seen as a single movement united under the banner of modern mathematics. Reformers who made no use of modern mathematics tended to be left behind. Clearly they were not up-to-date. Distinctions among the goals and methods of the reformers who remained a part of "new math" tended to be blurred or lost sight of entirely, while the importance of the modern mathematics in their work tended to be exaggerated.

The reform movement aspects of the Commission's work fit well with the goals of yet another group interested in improving mathematical education, the general public and the government. In response to Cold War pressures, especially after Sputnik, this group wanted rapid, widespread improvements. None of the pioneering efforts already under way seemed ready to offer this in the late 1950s. Most were directed at only a part of the curriculum or some fairly specific problem, or had barely gotten under way. Perhaps the furthest along were:

1) the Van Engen-Hartung textbook series. This covered the early elementary grades at this time, and contained little modern mathematics (pp. 215-216).
2) the University of Maryland project which was developing a complete junior high school program incorporating modern mathematics (pp. 107-109).
3) Beberman's University of Illinois Committee on School Mathematics. They were developing a complete high school mathematics curriculum incorporating modern mathematics (pp. 100-107).

4) the curriculum proposed by the Commission on Mathematics of the College Entrance Examination Board. Although this curriculum had not been tried, and hardly any text materials for it developed, it was a program intended for widespread adoption, and one which had been well publicized in the mathematics and mathematics education communities (pp. 109-116).

In view of the involvement of professional mathematicians, and the vigorous advocacy by the Commission on Mathematics of modern mathematics as a value in itself, it is not surprising that the Van Engen-Hartung series did not become the "new math" program for the elementary school. Similarly, the desire for a rapid and widespread change eliminated the Illinois program, which required such large changes in a teacher's ideas about mathematics and about teaching that its founders deliberately restricted its dissemination to teachers they had personally trained and schools they could personally supervise. Thus, it appeared that if the government wanted "new math" now, one approach would be to start a crash program to flesh out the Commission on Mathematics' proposals and graft the resulting program to the Maryland junior high school program. While this sort of government sponsored crash program may not seem particularly novel to us today, it was certainly unprecendented in mathematics education in the late 1950s. Perhaps the model came from the wartime crash programs such as developed the atomic bomb. That had been about fifteen years earlier, and had certainly involved mathematicians. Although the situations were not entirely similar--it is easier to tell if an atomic bomb works than it is to tell if an educational reform works--this kind of government sponsored crash program was adopted as the means of spreading "new math."

The particular form taken was the School Mathematics Study Group (SMSG), sponsored by the National Science Foundation (pp. 120-139). SMSG quickly decided that the fastest way to effect widespread change was to produce and distribute textbooks incorporating what it felt to be the most needed reforms. Of course, textbooks can affect course content much more effectively than they can affect pedagogy. As a result, the SMSG texts reflected the content and viewpoint of modern mathematics much more completely and accurately than they reflected the pedagogical innovations that were the primary characteristic and purpose of the early "new math" programs. While SMSG borrowed from the work of these pioneers, they were not the principal leaders of SMSG, which was instead directed largely by mathematicians. Thus, its programs reflected primarily the desires of mathematicians for a modern mathematics program, and of the government for rapid change.

SMSG made only very limited efforts to develop the pedagogical side of its program. They conducted some tests to establish that the curriculum could in fact be taught to children and that children studying SMSG materials performed adequately on standardized tests. It seems to have been assumed as self-evident that if children could learn modern mathematics, they were better off for having done so, and that the greater the number of students who learned it, the better. Of course, if widespread study of modern mathematics, rather than improved learning on the part of students, were the goal, it was only necessary to maintain sales figures on SMSG's texts to see if this goal was being met. Little testing or observation of the students using the texts would be required.

Unfortunately, although rapid and widespread reform of mathematics teaching was a goal of the public and the government, learning modern mathematics was not. True, it was at first impressive to have children coming home from school knowledgeable in branches of mathematics of which their parents had never even heard. Indeed, this sort of feat was at first an effective attention getting device for "new math," especially among journalists infected with what David Hackett Fischer has labeled "the prodigious fallacy."

> The prodigious fallacy mistakes sensation for significance. Today, this form of error is widely disseminated by the mass media. Journalists use the word "historic" to describe earthquakes, hurricanes, five-alarm fires, floods, state funerals, typhoons, train wrecks, quintuplets, transatlantic canoe trips, and other curiosities or catastrophes which are chiefly remarkable for the fortunate fact that they rarely occur, or for the unfortunate fact that they occur at all. (Fischer, 1970, pp. 70-71)

However, while the apparent child prodigies produced by "new math" had great publicity value, their prodigiality was a two-edged sword. Teachers and parents soon became threatened by children who seemed to know more than they, or the expectation that they themselves should accomplish such prodigious feats. Finally, when the children who seemed so sophisticated about sets and the commutative law did not show a corresponding improvement in the kind of practical mathematics that balances checkbooks or launches Sputniks, the public, and many mathematics educators, began to rebel against "new math" in general, and "modern math" in particular (pp. 212-222).

It is important to bear in mind that by the time "new math" actually reached a large number of schools and students, the principal thing distinguishing it from the "old math" was its incorporation of "modern mathematics." Furthermore, this incorporation did not include any significant amount of <u>useful</u> modern mathematics, such as linear programming, or even statistics. Instead, it was almost entirely limited to the vocabulary of modern mathematics, and old fashioned mathematics presented from a modern point of view. Now a point of view is a difficult thing to disseminate. Many teachers commented that the only difference between the old and the new was the vocabulary. For these teachers, inculcation of the spirit of modern mathematics was replaced by vocabulary drill. Furthermore, these were teachers with fairly positive feelings toward "new math." Others just taught around it. All in all, it is unlikely that many students profited from what modern mathematics had to offer. Perhaps with better trained teachers, the "new math" that reached the schools could have been an improvement over the old. Actually, there is little documentation showing that it was in fact worse, and some people felt that it in fact <u>was</u> an improvement, although not so large an improvement as had been hoped.

In any case, by the mid-1960s, when the "new math" had become widespread, it had also become controversial, as its value and success began to be questioned. If the "new math" that reached the schools had actually represented the ideas of the "new math" pioneers, and if the forces that had brought the "new math" to the schools had still been operating, then there might have developed an intense battle over the pros and cons of "new math." Instead, most of the pioneers had been alienated from the movement as it grew. Mathematicians, once the SMSG texts had been produced, returned for the most part to college teaching and

research. The public, which had seen technology and keeping ahead of the Russians as major goals, was beginning to question our role in Viet Nam and the impact of technology on the environment. The U.S. had caught up in the space race just as public interest in that race began to decline. Young people turned from academic or career interests toward personal growth, spiritual awareness, and drugs. The disappearance of all the vital forces that brought the "new math" into being left it an empty shell that crumbled rapidly under the attack of disgruntled parents and teachers. In addition, the disappearance of those forces left the "new math" relatively unsupported and undefended, making its "failure" appear, perhaps, much greater than it was.

Whether that failure was real or apparent, it is certainly true that the "new math" fell far short of what was expected of it. In addition, it was hardly a fair test of the ideas and ideals of the men and women who developed the original "new math" programs. Their feelings about SMSG's impact on curriculum reform were perhaps best stated by Jerrold Zacharias: "They took it away from us." "They" may have taken the money and the publicity, but those were mixed blessings to begin with. The tragedy is that the programs that reached the schools did not--could not--fulfill the hopes of the pedagogical pioneers, and the public, for dramatically more and better mathematical learning. In disillusionment, the public abandoned both those hopes and those pioneers. Perhaps the time has come to revive them, for we need the values they represented just as badly today as we did then.

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